Pepper Production, Disease and Insect Control

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GARDEN PEPPERS are native to tropical America. They are gradually becoming more popular in home and market gardens, for canning, and for preservation in brine or by drying. Although not a major vegetable, they merit more extensive use because of their attractiveness in flavor and color and their high vitamin content.

Peppers require warm weather, but suitable varieties are available for all except the coolest parts of this country. They can be grown in any soil that is suitable for other vegetable crops. Cultural requirements and practices are similar to those for tomatoes. The pepper plant, however, requires somewhat more careful handling and a little warmer weather than does the tomato, and it does not recover so well after unfavorable moisture, temperature, or other conditions that retard growth.

This bulletin describes the more common varieties of peppers, methods of culture, and control of diseases and insects.

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PEPPER PRODUCTION, DISEASE AND INSECT CONTROL

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PEPPERS IN THE UNITED STATES

THE GARDEN PEPPER, native to tropical America, is unrelated to the vine that produces black pepper. It belongs to the same family as tomatoes and potatoes, also of American origin. It is a bushy annual plant that grows from 2 to 4 feet high. Black pepper comes from a perennial vine that is native to the hot, humid forests of southern Asia. The garden pepper is believed to have been first called pepper by Columbus and his shipmates, who discovered the hot varieties that were grown by the natives of the West Indies.

PRINCIPAL TYPES AND USES

The varieties of garden peppers may be classified in two main types: Those with (1) mild- or sweet-fleshed fruits, and (2) hot- or pungent-fleshed fruits. Within each of these groups is a remarkable range of sizes, shapes, and colors of fruits, and sizes and growth habits of plants.

Most of the popular mild, or sweet, varieties have relatively large fruits, 2½ to 4 inches in diameter and 4 to 5 inches long. They are used as a fresh green vegetable, are canned, or are pickled in brine for use in salads or other foods. Diced green or red sweet peppers are sometimes mixed with sweet corn or other vegetables. The so-called pimiento type of pepper in America; usually of the Perfection variety, is canned extensively for use in preparing such foods as pimiento cheese and the red stuffing for olives.

Paprika, also a mild type of pepper, has been grown commercially in the United States only since the

beginning of World War II. The fruit is about 1 to 1½ inches in diameter and 5 to 6 inches long. Our supplies of the condiment paprika prior to World War II were imported, and still are, largely from southern Europe. The paprika type of pepper was developed in Europe, where it has been grown extensively for a long time. The brilliant red powder called paprika, used for flavoring and adding color to certain food preparations, consists chiefly of the dried, finely ground fruit walls of this type of pepper.

Most of the hot, or pungent, varieties of peppers are used chiefly for flavoring because their pungency is too strong for them to be eaten alone. Some varieties are especially fiery, but even the less fiery are generally considered too hot for any but flavoring purposes. These varieties range in size and shape from small cherrylike fruits through conical forms to slender fruits up to 8 inches in length. Red pepper and Cayenne pepper powders are the ground, dried fruits of some of the larger hot varieties. Chili peppers show a wide range of sizes, the larger of which are usually dried for use, while the smaller kinds are usually pickled. The tiny Tabasco type is most commonly pulped in the preparation of extremely pungent sauces.

Pepper flowers are largely cross-pollinated. It is, therefore, difficult to keep varieties true to type if seed is collected from plants grown near other pepper varieties. Hot and mild varieties will cross readily, as will those of different shapes or other characteristics, giving rise to forms that will be highly undesirable.

DISTRICTS OF PRODUCTION

The principal districts in which green peppers are grown in the United States for fresh market are as follows: Southern, west-central and north-central Florida; the parishes in the vicinity of New Orleans, the Winter Garden and lower Rio Grande Valley districts of Texas; southeastern North Carolina; southern New Jersey; Santa Clara County and the southern coastal counties in California. Small market-garden acreages are generally scattered over most of the United States.

Pimiento peppers for canning are grown almost entirely in central Georgia, with a small acreage in southern California. Other varieties of mild, or sweet, peppers are also canned or packed in brine on a fairly large scale on the Eastern Shore of Maryland and Delaware.

The growing of paprika peppers in this country is confined almost entirely to small areas in southern California and southeastern Arizona. Several hundred acres were grown in eastern South Carolina, principally around Dillon, during World War II. This enterprise was discontinued in 1946, because competition from imported paprika made production unprofitable.

Chili peppers are grown and dried commercially on a large scale southeast of Los Angeles, Calif., and along the upper Rio Grande watershed in New Mexico. They are generally grown to a limited extent throughout the farming districts of the Southwest. To an increasing degree, green chili peppers are canned.

The Tabasco type of pepper is grown commercially only in southern Louisiana.

ECONOMIC IMPORTANCE

From 1940 to 1957 the acreage of sweet peppers for market in the United States almost doubled to nearly 44,000 acres and 11 million bushels, with a 1957 farm value of about $26.5 million. From 1940 to 1955, the last year for which official estimates are available, the acreage and production of pimientos for

canning fluctuated widely, from a low of 16,600 acres and 8,600 tons in 1944 to 32,000 acres and 44,800 tons in 1950. In 1955 there were about 26,500 acres of pimientos and production of about 34,500 tons with a farm value of more than $3 million.

No official estimates of acreage and production of paprika or of hot kinds of peppers have been made by this Department.

Estimates by the Bureau of the Census indicate that between 8,000 and 9,000 acres of chili, Cayenne, and other hot types were grown in 1954, chiefly in the South and Southwest. The acreage of paprika reached a high point early in World War II when 1,000 to 2,000 acres were grown in South Carolina, Louisiana, and California according to unofficial local estimates. After the war the acreage declined when imported paprika from southern Europe was again available. In 1957 a few hundred acres were grown, chiefly in southern California.

CLIMATIC REQUIREMENTS

Peppers require more heat and are more sensitive to cold than most common garden plants grown in this country. Peppers not only will be killed by even a light frost but will fail to thrive during cool periods when temperatures are in the 40° to 60° F. range, safely above the danger of frost. Most varieties require a little more warmth than tomatoes—a daily average temperature of about 75°. The later, longer growing varieties, such as Perfection pimiento and Tabasco, require considerably more warmth. A few early varieties, such as Early Giant and Windsor-A, can be grown successfully in the milder parts of the New England States and in other northern States at low elevations. None are well adapted to the cool mountain or high northern plains districts. At least 3 months of warm weather for plants in the field or garden is required for good yields of the earlier varieties adapted to the more northerly part of the country, and 4 to 5 months for most other varieties. (See pp. 8 to 12.)

Despite the pepper's need for plenty of warm weather, the extreme heat of midsummer in many parts of the South and Southwest is too high for fruit-setting in most varieties. Above 90° F., blossom dropping becomes excessive, and many fruits that set at mean temperatures above 80° are likely to be small or poorly shaped because of heat injury to the blossoms. Above 95° few, if any, fruits will set, especially if the air is very dry or if there are drying winds. Fruit setting will begin again with the return of milder weather.

The small- to very small-fruited varieties are much more tolerant of hot weather than are the large-fruited varieties.

All large-fruited varieties tend to drop many of the flowers that form after several fruits have started to develop on a plant. After some, or most, of these early fruits have been harvested, fruit setting will be resumed if weather and soil conditions are favorable.

SOILS AND FERTILIZERS

Good crops of peppers can be grown on any good garden or truck-crop soil. They are grown successfully on many kinds of soils, ranging from fine sands through sandy loams, loams, clay loams, and silt loams; but sandy loams and loams are preferred. The soil must be well drained.

The pepper plant is not especially sensitive to soil acidity. Strongly acid soils, however, should be limed to a moderately or slightly acid condition. Do not guess at the amount of lime to apply. Apply only what is indicated by a dependable lime determination, made according to

the recommendation of the county agricultural agent or the State agricultural experiment station.

If the soil is not naturally fertile, manures or green manures and commercial fertilizer will need to be applied because a rich soil is necessary for producing high yields of good-quality peppers. To maintain the soil organic matter, 10 to 15 tons of stable manure, compost, or green manure should be turned under annually.

Peppers should be fertilized in approximately the same way as tomatoes, but with a little more nitrogen and potash. It is perhaps even more important than with tomatoes to insure that there is ample fertility to make the plants start off and grow rapidly after transplanting, lest they start blooming and fruit setting while they are too small. Fruit setting on small plants definitely stunts their growth so that they fail to develop the plant size necessary to produce a good crop of fruit. Pepper plants generally make rather poor recovery from any serious stunting.

On loam and heavier soils of fair to good fertility 500 to 600 pounds per acre of fertilizer containing 4 to 5 percent nitrogen, 6 to 8 percent phosphoric acid, and 6 to 8 percent potash should be thoroughly mixed with the soil along the rows about a week before transplanting the plants. When the plants have set several fruits each, additional nitrogen is needed to prevent the plants from slowing down in vegetative growth. At this time about 150 pounds of nitrate of soda (or 100 pounds of ammonium nitrate or 125 pounds of ammonium sulfate) should be applied per acre as a top dressing near the rows and cultivated into the soil.

On the lighter, sandier soils, 750 to 1,000 pounds per acre of a 5–8–8 or 5–10–10 fertilizer should be worked into the soil before transplanting time, and a top dressing of the same type of fertilizer should be applied at fruit-setting time. On these lighter, sandier soils, 50 pounds of muriate or sulfate of potash should be added to the nitrogen top dressing.

PEPPERS IN THE CROPPING SYSTEM

As peppers are grown in widely different parts of the United States along with a large variety of other vegetable and field crops on individual farms, it is not practicable here to recommend specific crop rotations that include peppers. More important than following a particular rotation over many years is the precaution to avoid growing peppers on the same soil more often than once in 3 or 4 years. As tomatoes and peppers are subject to some of the same diseases, neither should follow the other in successive seasons in the same soil.

Soil used for plant beds should have had no peppers grown in it for many years, preferably never before.

PROPAGATION

SOWING IN PLACE

Although much the greater part of the total acreage of all kinds of peppers is grown from transplants, seed is sown directly in place in the open field in a few districts, principally in some of the warmest parts of the country. A limited part of the pimiento acreage in central Georgia and most of the chili pepper acreage in Orange County, Calif., and in the Southwest are planted in place. In Georgia about 2 pounds of seed per acre is drilled thinly in rows 3½ feet apart at about the average date of the last frost. The plants are later thinned to stand 2½ to 3 feet apart in the rows. In Orange County, Calif., about 3 pounds of chili seed per acre is drilled in rows 3½ feet apart between March 15 and May

15. The plants are thinned when 3 to 4 inches tall to stand 1½ feet apart in the rows. In New Mexico much of the acreage is planted in hills about 2 feet apart in rows 3½ feet apart—planting 10 to 12 seeds and later thinning to 2 plants. The costs of production by sowing in place are nearly the same as by transplanting because of the costs for more seed, for thinning, and for additional cultivation to control weeds. Sowing in place is not generally recommended, even in districts where the season is long enough to permit its use.

GROWING PLANTS FOR TRANSPLANTING

Open-Field Plant Beds

Many acres of outdoor plant beds, or fields, in the lower South are used to grow pepper plants for shipment to gardeners and truck farmers to the north. However, pepper plants are somewhat more difficult to grow, ship, and deliver to the field in good condition for transplanting than are tomato plants. Pepper plants are harmed more than tomato plants by unfavorable conditions in the plant bed, in transit, or upon delivery. Shipped plants, therefore, are used for a smaller percentage of the total pepper acreage than for the tomato acreage.

Outdoor beds should be planted on a moderately fertile soil that is well drained and that is mellow enough to permit many of the roots to remain attached when the plants are pulled from the beds. Very rich soils may produce plants that are too large and succulent at transplanting time. Outdoor beds require much more seed than covered beds because large numbers of seed fail to produce desirable plants under outdoor conditions. In the outdoor beds about 20 seeds are sown per foot of row in rows 8 to 16 inches apart, depending on the fertility of the soil and the equipment available for weed and pest control. The 8- and 16-inch spacings require about 20 and 10 pounds of seed, respectively, per acre of plant bed. Under good conditions ½ pound of seed should produce more than enough plants—6,000 to 7,000 of most varieties—to transplant an acre, but some growers sow as much as a pound. Plants should be large enough for transplanting in about 7 to 8 weeks after sowing of the seed.

Hotbeds and Coldframes

Coldframes may be used effectively for starting peppers in a narrow belt to the north of those districts where open-field planting or plant beds are possible. Hotbeds are recommended, however, in all districts where the average date of the last spring frost is March 30 or later.

It is probable that most readers considering the growing of pepper plants for transplanting are already familiar with the construction of one or more of the common types of hotbeds. Detailed instructions on building, heating, and managing hotbeds will be found in Farmers' Bulletin 1743, Hotbeds and Coldframes, which can be obtained free by writing to the Office of Information, United States Department of Agriculture, Washington 25, D. C.

Pepper seed should be sown in the hotbed about 8 weeks before normal transplanting time. In most parts of the country this will be about a month before the average date of the last spring frost.

If a very early harvest is sought, seed should be sown thickly in a flat or a portion of the hotbed. As soon as the seedlings are large enough to handle and before the true leaves appear, they should be transplanted into the hotbed during a relatively warm, bright interval. The plants should be set into a

moderately rich soil-compost mixture in pots, plant bands, flats 3 inches deep, or into hotbed soil that has been prepared to a depth of 3½ to 4 inches. The larger containers or wider spacings in the flats or beds allow more room for plants to develop to large size before they are transplanted. However, the cost of producing these plants is greatly increased. Seedlings may be set singly in 3- to 4-inch pots or bands, in flats about 3 by 3 inches, or set directly in the hotbed soil about 3 by 3 or 4 by 4 inches apart in rows that are straight both along and across the bed.

Plants from pots or bands recover from transplanting more quickly than those grown in flats or directly in the soil of the beds, because the root system is disturbed less when the plants are moved. A few days before moving plants out of the bed, those in flats or the soil of the bed should be blocked out by running a heavy knife through the soil halfway between the rows, leaving each plant in the center of a square of soil. This will permit easy removal of the plants to the field with a minimum of root disturbance.

Large fields of peppers for shipping, canning, or drying are generally set with plants that have been grown from seed sown thinly in the beds and that have been undisturbed until ready to be moved to the field. This method produces a far greater number of plants per square foot of plant bed at much lower cost than the methods mentioned in the preceding paragraph. The plants are necessarily smaller because they are crowded in the bed. Although the plants generally develop more slowly because of crowding, it is necessary to avoid leaving them in place so long or so close together that they become too tall and spindling.

If the plants are to remain in place in the beds until moved to the field, about 20 seeds should be sown per foot of row, as uniformly spaced as feasible, in rows 6 inches apart. After emergence, the plants should be thinned to give approximately equal spacing for 12 to 15 plants per foot of row. This will give about 500 plants per yard in beds 6 feet wide.

The soil temperature should be kept between 70° and 75° F. before emergence of the seedlings, and after emergence between 65° and 70°. Air temperature of the beds after plant emergence should be kept at about 65° at night and at about 75° during the day. The beds will require careful attention to ventilation and covering to control temperature. The beds should be watered during bright, warm mornings insofar as possible, so that excess surface moisture can evaporate before it induces damping-off or other diseases and so that the plants will not become chilled while the beds are uncovered.

The covers should be left open or off the beds to an increasing extent as the plants approach transplanting size (fig. 1). For a week before transplanting time, the beds should remain open, unless a cold spell or a storm threatens injury. At transplanting time the soil near the plants can be loosened with a small tool and the plants can be removed with a fair number of roots attached.

TRANSPLANTING

Peppers should be transplanted to the open garden or field only after all danger of frost is past and the weather has become definitely warm. In most parts of the country it is well to put peppers into the field about 1 week after the frost-free date or 4 weeks after the average date of the last spring frost. In general, the plants should not be set out until the new leaves of the oak trees have become full-grown. Earlier planting is often followed by cool weather that holds back growth and tends to interfere with

later growth by stunting the plants.

Most varieties of peppers are set approximately 2 feet apart in rows 3 to 3½ feet apart; about 7,000 plants per acre. Some of the larger growing, later sorts, such as Perfection, are set 2½ to 3 feet apart in rows 3½ feet apart; about 4,400 to 4,900 plants per acre. Planting too close on rich land may crowd the plants causing them to become too tall and spindling, and therefore more susceptible to breakage by wind.

Large plants in pots, bands, or with masses of soil about the roots must be transplanted by hand. Smaller plants, 4 to 8 inches long, pulled from the plant bed, are best transplanted by a machine equipped with a watering device. Plants should receive a cup of water or starter solution about the roots after some soil has been pulled to the roots, but before the soil is finally firmed about the plant. Commercial preparations of soluble chemicals are available for making starter solutions. A homemade mixture of 5 pounds of commercial fertilizer analyzing about 5 percent nitrogen, 8 to 10 percent phosphoric acid, and 5 percent potash in 50 gallons of water is also effective.

Tests in transplanting other vegetable plants have shown that a well-organized crew of a driver and 2 men to handle plants on a 1-row planter can set 3,500 to 4,000 plants per hour; or a 5-man crew with a 2-row planter can set 7,000 to 8,000 plants per hour, if little time is lost waiting for plants or while refilling the water tank on the planter. The small grower who cannot justify the purchase of a planter for his individual use should consider joint purchase and operation of a machine with a group of his neighbors.

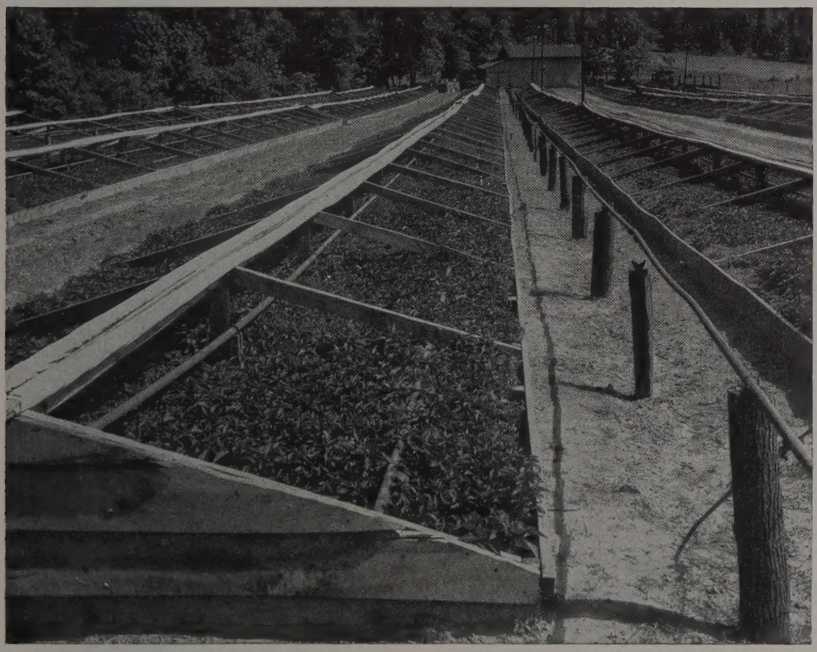

Figure 1.—*Large, steam-heated hotbeds for growing plants. Cloth covers are rolled to the ridge. Irrigation sprinkler pipes have been installed between the beds. These plants are ready for transplanting.*

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In nonirrigated districts the land for peppers is worked flat unless ridges are necessary for surface drainage in areas where rainfall is heavy. In districts where furrow irrigation is used the plants are transplanted on 1- or 2-row beds between the irrigation furrows. Spacings within rows and numbers of plants per acre are approximately the same as for nonirrigated land, but the distances between rows are governed by the irrigation practice that must be followed in the individual locality.

CULTIVATING

No special methods are required in cultivating peppers. Shallow cultivation, not more than 1 to 2 inches deep, often enough to control weeds effectively, is all that is necessary. Care should be taken to avoid cultivating or other work on the soil when it is too wet. Repeated trampling during successive harvests tends to pack the soil to an undesirable degree if it contains much clay or silt, especially when it is walked upon while the surface is wet.

Pepper plant stems and branches are brittle and are more easily broken by wind or by farm implements than the stems and branches of most crops. Care should be taken to avoid striking or roughly pushing the plants about while working among them.

IRRIGATING

Peppers, like many other vegetable crops, require a reasonably uniform soil-moisture supply during the growing season for best production. Long dry periods may cause shedding of flowers and young fruits, and pepper plants are likely to make a rather slow recovery after drought injury. Where rainfall is insufficient, water may be applied by sprinkler- or furrow-irrigation systems. The number and frequency of irrigations needed to maintain a steady rate of growth will depend on soil type, humidity, and prevailing temperatures. In the Winter Garden section of Texas, where part of the moisture is supplied by rainfall, peppers are usually irrigated 3 or 4 times during the crop season. In the warmer parts of New Mexico and Arizona where there is little rain during the growing season, an average of 11 irrigations is required to produce a crop of peppers. In these sections peppers are estimated to require between 24 and 30 acre-inches of water, or slightly less than is required to produce a cotton crop. In some sections up to 40 acre-inches of water is used in about 12 irrigations.

In the irrigated sections of the Southwest the furrow system is commonly used for applying water, but in areas where the fusarium wilt disease is common a furrow-ridge system of irrigating is used. In this method the pepper transplants are set at the side of the furrow at transplanting time. During the season the soil is worked toward the plant row until at harvesttime the plants are in the center of a bed 8 to 10 inches high. This system has been found to be very effective in reducing damage from fusarium wilt.

VARIETIES

MILD VARIETIES FOR MARKET

The most popular mild-fleshed pepper varieties for use as a fresh vegetable or for brining are 3½ to 4½ inches long and have maximum diameters nearly as great as their length. They are typically 3- or 4-lobed and taper only slightly toward the blossom end. Some of the longer, more tapering varieties are satisfactory for use in salads but are losing in popularity because they are not so well suited for the preparation of stuffed-pepper dishes.

All the varieties except Neapolitan listed in this group are dark green when immature and turn brilliant scarlet at maturity. They are generally used green but also to a small extent in the red-ripe stage, because of the attractive color. Brief characterizations of some of the more important of these varieties follow. The number of days given is the approximate time from transplanting to first harvest at the green-mature stage.

California Wonder.—About 75 days. Fruits about 4¼ inches long, 3¾ inches in diameter, mostly 4-lobed, little or no taper, very smooth and attractive (fig. 2). Slightly smaller and earlier (65 to 70 days) strains of this type are also available under the name of Early Calwonder.

Chinese Giant.—About 82 days. Fruits about 4½ inches long, diameter nearly as great, 3- or 4-lobed, little taper, blossom ends tend to be crumpled and rough (fig. 3).

Neapolitan.—About 60 days. Fruits about 4 inches long and 2 inches in diameter, 3-lobed, tapered, yellowish green to greenish yellow when immature, bright red when mature.

Figure 3.—*Chinese Giant pepper.*

Windsor-A.—About 58 days. Fruits about 4½ inches long, 2¼ inches in diameter, 3-lobed, tapered only slightly except near blossom end, tend to be slightly crumpled or irregular; the earliest pepper of this type; developed for New England and other cool regions.

Figure 2.—*California Wonder pepper.*

Figure 4.—*Harris Early Giant pepper.*

Figure 5.—*Ruby King pepper.*

Harris Early Giant.—About 63 days. Fruits about 4¼ inches long, 3¼ inches in diameter, typically 3-lobed, large and block-shaped with little taper, smooth; one of the earlier peppers (fig. 4).

Ruby King.—About 68 days. Fruits up to 5 inches long, 2½ to 3 inches in diameter, typically 3-lobed, distinctly tapered, often irregular (fig. 5).

World Beater.—About 70 days. Fruits up to 5 inches long, 3¾ inches in diameter, distinctly 4-lobed, little taper, but not crumpled or irregular.

Harris Early Giant and Windsor-A are early varieties that are adapted to regions of relatively short, cool seasons. Ruby King is an old, well-established, widely adapted variety that has given way in popularity to the smoother, thicker, nontapered forms, such as California Wonder and World Beater. Chinese Giant is productive and widely adapted, but it is a little later and a little rougher in form than generally desired. California Wonder and the earlier named strains of it are the most popular because of their highly desirable size, shape, and smoothness. World Beater, the second in importance, is probably a little more widely adapted and a more dependable producer than California Wonder, except under the most favorable conditions. Mild varieties with tomato-shaped or yellow-colored fruits are relatively unimportant.

MILD VARIETIES FOR PROCESSING

The Perfection, a large variety of the pimiento type of pepper, is grown almost exclusively for canning; few other varieties are canned to a large extent. The Perfection variety is not well adapted to the northern half of the country. A brief characterization follows:

Perfection.—About 80 days to red ripe. Fruits about 3½ inches long and 3 to 3¼ inches in diameter, smooth and symmetrical, top-shaped or short-conical, sometimes described as heart-shaped, walls unusually thick and firm, suiting the variety to canning.

In the Maryland-Delaware-New Jersey area a part of the pepper crop is grown for preservation by canning or in brine. California Wonder and similar varieties are so used.

HOT VARIETIES

The main commercial types of hot-fleshed peppers are the long, thick chili, the long, slender Cayenne, and the small, pointed Tabasco. The most popular chili varieties range from 3 to 7 inches long and have maximum diameters of 1 to 1½ inches. Strains of Mexican chili, which have been grown in the Southwest for many years, are gradually being replaced by somewhat milder varieties with large, smooth fruits that can be easily peeled for canning. Improved varieties of Cayenne peppers developed by the South Carolina and

Louisiana Agricultural Experiment Stations are earlier, easier to pick, and more pungent than the older Cayenne types. The newer varieties have smooth, slightly curved pods that are 4 to 6 inches long and ½ to 1 inch in diameter. Tabasco peppers are small and very hot, and are usually about 1 to 1½ inches long and ⅜ inch in diameter.

The more important varieties of hot peppers are characterized briefly below.

Anaheim chili.—About 115 days to green mature and 150 days to red ripe. Fruits about 7 inches long, 1½ inches in diameter and slightly tapered, stem end usually without pronounced shoulder but often wrinkled or folded (fig. 6).

Figure 6.—*Anaheim chili pepper.*

Flavor mildly pungent as compared with other chili varieties.

Mexican, or "native," chili.—About 105 days to green mature and 125 days to red ripe. Fruits about 3 inches long, 1½ inches in diameter, somewhat conical in shape and tapering to a blunt point. Pods generally have a deep shoulder at the stem end and are often furrowed and wringled. Most pungent of the large-fruited chili varieties.

College No. 9 chili.—About 115 days to green mature and 150 days to red ripe. Fruits about 5 inches long, 1¾ inches in diameter, tapered and pointed, shoulders sloping and usually smooth, which facilitates peeling for canning. Considerably less pungent than Mexican chili but slightly more pungent than Anaheim.

Long Thick Cayenne.—About 100 days to green mature and 120 days to red ripe. Fruit 4 to 6 inches long (some strains 7 to 8 inches), 1 inch in diameter, tapered, generally curved, often somewhat crumpled or twisted, typically 2- or 3-celled. Flesh thin, very pungent (fig. 7).

Long Thin Cayenne.—About 100 days to green mature and 120 days to red ripe. Fruits 4 to 6 inches long (some strains 7 to 8 inches), ½ to ⅝ inch in diameter, tapered, generally curved, often crumpled and twisted, typically 2- or 3-celled. Flesh thin, very pungent.

Tabasco.—A very late-maturing variety. Fruits about 1½ inches long, ½ inch or less in diameter, very thin-walled (fig. 8). Grown commercially only in Louisiana.

Sport.—A late-maturing variety. Fruits 2½ to 3 inches long and about ½ inch in diameter, dark red, blunt-pointed. An important variety in the New Iberia section of Louisiana.

Strains of Mexican, or "native," chili are widely grown in the Southwest, particularly in central and northern New Mexico, where they

Figure 7.—Cayenne pepper (long thick strain).

are preferred for earliness. In sections where part of the crop is harvested green for market or for canning, the Anaheim and College No. 9 chili are more popular because of their large smooth pods. The chili variety No. 6, released by the New Mexico Agricultural Experiment Station in 1950, is said to be superior to the older varieties in yield and pod shape.

Practically all of the commercial types of paprika peppers grown in this country have been introduced from southern Europe. In local areas of production selections have been made for color, shape, and thickness of pods, and flavor of the ground product. Some of the local selections have become fairly well fixed as to type but none of them are established as varieties. The so-called Hungarian paprika has been grown more widely in the United States than any other type of paprika. The Spanish type has been grown to a limited extent in California.

Hungarian Paprika.—Fruits 2 to 5 inches long, depending upon

Figure 8.—Tabasco pepper.

the strain; shapes vary from conical-pointed to oblong-tapering; walls thin. When first introduced some strains were slightly pungent but nonpungent strains with improved flavor have been selected.

Spanish Paprika.—Fruits 5 to 9 inches long, walls thick. Ground powder is bright red and has a very desirable flavor.

The Spanish type is easily distinguished from the smaller Hungarian type. The larger, thicker fleshed pods of the Spanish are the more difficult to dry successfully. The Spanish is also more susceptible to disease in the field. These two disadvantages have limited the acceptablity of the Spanish to growers in most localities.

INSECT ENEMIES AND THEIR CONTROL [1]

Peppers are attacked by many kinds of insects, the most important of which are aphids,[2] cutworms,[3] flea beetles,[4] hornworms,[5] the pepper weevil,[6] the pepper maggot,[7] and leaf miners.[8] Some of these insects are widely distributed; others are serious pests in limited areas only.

[1] Prepared by the Entomology Research Division.

[2] Principally the potato aphid (*Macrosiphum solanifolii*) and the green peach aphid (*Myzus persicae*).

[3] *Feltia subterranea* (F.), and *Peridroma margaritosa*.

[4] *Epitrix* species.

[5] Tomato hornworm (*Protoparce quinquemaculata*) and tobacco hornworm (*P. sexta*).

[6] *Anthonomus eugenii*.

[7] *Zonosemata electa*.

[8] *Liriomyza* spp.

TC-7279

Figure 9.—Applying insecticide dust to peppers with a power duster.

APHIDS

Aphids, or plant lice, are small, soft-bodied, and are mostly on the undersides of the leaves or on the stems and terminal clusters. They are the most common and widely distributed insect pests of peppers. It is important to dust or spray the plants as soon as the first infestation is evident and as often as necessary thereafter. Controlling a light infestation is usually not difficult, but if control measures are neglected until the peppers are heavily infested, the damage may be serious and the success of the application doubtful.

Aphids on peppers can be controlled with dusts or sprays containing malathion or parathion. Five-percent malathion, or 1-percent parathion dusts are effective. For use in sprays the following preparations are effective at the indicated dosages per acre: 6 pounds of 25-percent malathion wettable powder; 1½ pints of 50-percent emulsifiable concentrate; 1 pint of 25-percent parathion emulsifiable concentrate. See precautions on page 17.

In areas where the use of DDT for other insects induces high aphid populations, use a DDT dust or spray containing malathion or parathion according to the dosage given above.

CUTWORMS

Cutworms are stout, soft-bodied, smooth worms, dull gray, brown, or black, and may be spotted or striped, up to 1½ inches long, and they curl up when disturbed. They may damage peppers wherever this crop is grown. They can be controlled readily with a poisoned bait containing 25 pounds of dry bran and 1 pound of toxaphene.

To prepare this bait, thoroughly mix the poison with the bran and then add enough water to make a crumbly mash, stirring slowly all the time. Large quantities can be made up in galvanized-iron or wooden washtubs and small quantities in buckets or similar containers.

Either broadcast the poisoned bait before the crop is set in the field or sow it by hand along the rows or about the base of the plants. Do

this late in the evening, so that the bait will not dry out before the cutworms start feeding on it. From 10 to 15 pounds of the wet bait per acre is enough for one application. Spread a smaller quantity where the bait is applied directly to the rows or hills. Two or three applications 2 days apart may be needed to rid the field of the pests.

Cutworms can also be controlled by a dust containing 10 percent of DDT or toxaphene applied on the soil surface around the plants.

FLEA BEETLES

Flea beetles are small, black, brown, or striped jumping beetles. They damage peppers wherever this crop is grown. They feed extensively on the small plants and are sometimes numerous enough to cause serious damage to large plants.

Flea beetles can be controlled by applying a dust containing 5 percent of DDT or methoxychlor, 1 percent of parathion or rotenone. The following sprays are also effective against these pests when prepared and applied at the specified strengths per 100 gallons: 2½ pounds of 50-percent DDT wettable powder; 3 pounds of 50-percent methoxychlor wettable powder or 3 pints of emulsifiable concentrate; 1 pint of 15-percent parathion emulsifiable concentrate. Apply the dust or spray when damage by flea beetles is first noticed, and at 5-day intervals until the infestation is controlled.

HORNWORMS

Hornworms are large green worms with diagonal lines along the sides and a prominent horn on the rear end. They devour the leaves of pepper plants and when numerous may entirely strip the plants. Ordinarily, in small fields they can be controlled by hand picking. For larger fields, hornworms can be controlled by dusting with 10-percent DDT or TDE. These same materials can be applied as sprays using 4 pounds of 50-percent wettable powder or 1 gallon of 25-percent emulsifiable concentrate per acre.

Make the first application when hornworms become numerous and repeat the treatment at weekly intervals, if necessary.

PEPPER WEEVIL

The pepper weevil is an important pest of peppers in California, Arizona, New Mexico, Texas, and Florida. It was reported in Georgia in 1946 but has not appeared since. It was also reported in New Jersey in 1957. Both the grub and the adult weevil damage peppers. The grub confines its feeding to the blossom buds and the pods. The injured blossom buds and small pods fall to the ground and the larger pods become misshapen or discolored. The adult weevil feeds on the leaves, blossom buds, and tender pods, but it causes less damage than the grub.

The grub is about ¼ inch long, is grayish white, and has a pale brown head. The adult weevil is about ⅛ inch long, black, and sparsely covered with gray or yellowish hairs.

In areas with mild winters the pepper weevil carries over from one season to the next, either on old

TC—7282

Figure 10.—*The adult pepper weevil.*

TC–3821

Figure 11.—*Small grub of the pepper weevil in blossom bud of pepper.*

pepper plants or nightshade in or around the fields. If pepper fields are carefully plowed as soon as harvest is over and nightshade plants around the edges of the field are destroyed, the pepper weevils will be deprived of food, and the number surviving will be greatly reduced. The pepper weevil infestation on the subsequent crop will also be reduced, and delayed. Early destruction of old pepper fields and nightshade at least 30 days before planting the new crop is thus an important cultural practice.

The pepper weevil cannot survive the winter in cooler areas such as New Mexico, Georgia, or New Jersey because it must have living plant material the year around but have been known to be brought in on plants raised in milder areas such as California and Florida. Growers should accept only plants grown in uninfested areas or which have been carefully treated in the seedbed and guaranteed free from infestation.

The pepper weevil may be controlled by dusting the plants with 10-percent DDT. DDT may also be applied as a spray at the rate of 2 to 2½ pounds of the 50-percent wettable DDT powder to 100 gallons of water.

At the first sign of infested buds or pods apply the DDT every 10 days until most of the pods have matured. If the infestation is very heavy, make the first three applications at shorter intervals (7 days). Three or four applications will control a light infestation but 7 or 8 may be required for a heavy or an early infestation.

In Texas, dusts containing 20-percent toxaphene and sprays containing 2½ pounds of the 40-percent wettable powder in 100 gallons of water have given effective control of this insect. Both dusts and sprays may be applied according to the scheduled outlined for DDT.

PEPPER MAGGOT

The pepper maggot infests the pod of peppers in New York and New Jersey and sometimes causes serious losses. It has also been found on peppers in Mississippi and Connecticut. The full-grown maggots are about ½ inch long and are yellowish white. The adults are two-winged, yellow-striped flies about 3/10 inch long.

To control this insect apply a dust containing 1 percent of parathion, 1 percent of rotenone, or 5 percent of chlordane. Make the first application 2 days after the first flies appear in the field and repeat at 5-day intervals as long as any flies can be found.

LEAF MINERS

Leaf miners are important insect pests affecting peppers in Texas and Florida. They feed between the upper and lower surfaces of the leaves and sometimes are so numerous they cause all the leaves to drop off the plants.

Dusts containing 1 percent of parathion, 5 percent of chlordane, or 20 percent of toxaphene will control leaf miners. Sprays containing these materials are also effective at the rate of 1 pound of 15-percent parathion wettable powder,

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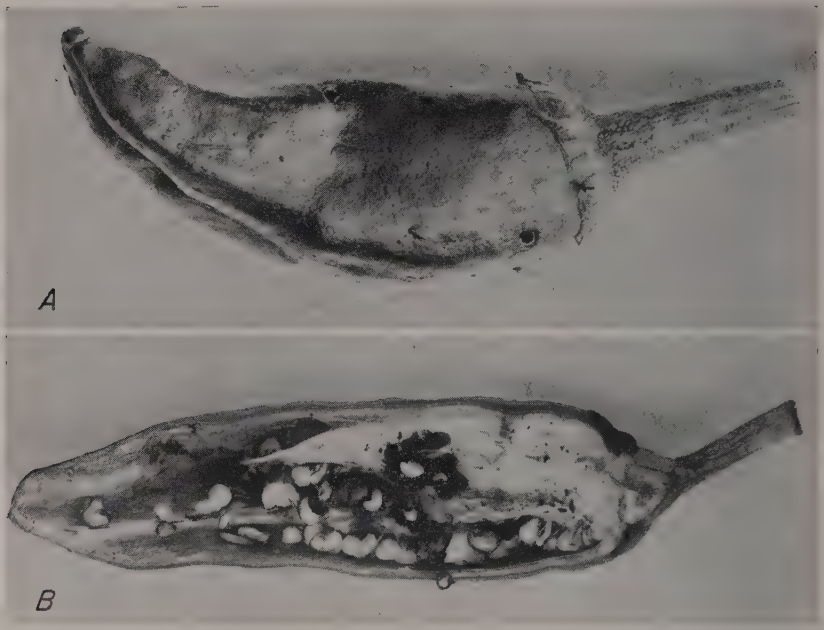

TC–4207 AND TC–3818

Figure 12.—*Pepper pods injured by the pepper weevil: A, pod showing holes made by the adult emerging from the pod; B, open pod showing black and decayed condition of seed and the pulp around the seed, caused by the grub.*

2 pounds of 50-percent chlordane wettable powder, or 2½ pounds of 40-percent toxaphene wettable powder per acre.

Apply these insecticides when typical serpentine mines or tunnels are first noticed on pepper leaves. Repeat the treatment three times at weekly intervals. If the infestation is severe additional treatments may be needed.

METHODS OF USING DUST AND SPRAYS

Insects infesting peppers can be controlled best by the use of insecticide dusts or sprays. These can be applied most effectively during calm periods of the day, usually early in the morning or late in the afternoon. Care should be taken to have the duster or sprayer in good working order. See that none of the nozzles are clogged, and that they are properly adjusted at the right heights and angles so that all parts of the plants will be thoroughly covered with the insecticide.

The rates of application will vary with the equipment, the size of the plants, and the type and strength of material. In general, where the application is made with traction or power equipment, from 25 to 30 pounds of dust or 50 to 125 gallons of spray per acre is needed. When hand equipment is used and the plants are small enough to be treated individually, 15 to 20 pounds of dust or 50 to 60 gallons of spray per acre is sufficient. If emulsifiable concentrates are used, as little as 10 gallons of spray per acre may be sufficient. Wettable powders require good mechanical agitation and high gallonage to prevent clogging of the spray nozzles.

PRECAUTIONS

Insecticides are poisonous. Use them only when needed and handle them with care. Follow the directions and heed all precautions on the container label. Insecticides should be kept in closed, well-labeled containers in a dry place where they will not contaminate food or feed, and where children and pets cannot reach them.

Good hygiene is advisable in the handling of all insecticides. Wear clean clothing, avoid repeated or prolonged contact with skin and inhalation of dusts and mists, and wash hands and face before eating or smoking.

DDT, malathion, methoxychlor, rotenone, and TDE can be used safely without special protective clothing or devices, provided they are in diluted dust or water spray form. However, most concentrates of insecticides require special precautions. When handling or mixing concentrates, avoid spilling them on the skin and keep them out of the eyes, nose, and mouth. If any is spilled, wash it off the skin and change clothing immediately.

Chlordane and toxaphene can be absorbed directly through the skin in harmful quantities. When working with these insecticides in any form, take the same precautions as with concentrates.

Parathion is extremely poisonous and may be fatal if swallowed, inhaled, or absorbed through the skin. It should be applied only by a person thoroughly familiar with its hazards and who will assume full responsibility for safe use and comply with all the precautions on the labels. Reduce the danger of skin exposure by wearing recommended protective clothing and equipment. Wear a respirator or mask of a type that has been tested by the U.S. Department of Agriculture and found to be satisfactory for protection against parathion.

Do not apply parathion to peppers within 15 days before a harvest, DDT or toxaphene within 5 days, malathion within 3 days, or TDE, methoxychlor, or rotenone within 1 day before a harvest.

Do not apply chlordane after the pods begin to form.

REMOVAL OF RESIDUES

When insecticides are used at the dosages recommended in this bulletin and the precautions are carefully followed there will not be hazardous residues on the harvested product. However, if excess dosages are applied or if insecticides are used too close to harvest, residues may accumulate in hazardous quantities, particularly in the cup that surrounds the stems of many types of peppers.

Some States may require that peppers from fields treated with certain insecticides be washed before they are dried or offered for sale. Information on requirements in your State is best obtained from your agricultural experiment station or county agent. Residues of DDT, toxaphene, and chlordane are very difficult to remove but they can be reduced substantially by careful washing. Use approved washing equipment in which the peppers are agitated for 1 minute in water containing 1 pound of a detergent washing powder per 50 gallons. Rinse thoroughly in clean water. It is desirable that samples of the pods be analyzed to make sure that the washing is effective.

DISEASES AND THEIR CONTROL

Peppers are subject to a number of diseases that reduce both yield

and market value of the fruit. Disease control is one of the most important factors in the production of profitable crops of peppers. The diseases that most commonly cause losses of peppers are damping-off, blue mold, bacterial spot, cercospora leaf spot, southern blight, phytophthora blight, fusarium wilt, anthracnose, ripe rot, mosaic diseases, blossom-end rot, sunscald, and root knot. Some diseases, such as blossom-end rot and sunscald, are associated with unfavorable conditions of soil moisture, temperature, or fertilization; but most of the common diseases are caused by parasitic organisms, chiefly fungi and bacteria, and by plant viruses. Losses from many pepper diseases can be avoided or greatly reduced by: (1) The use of clean seed protected by chemical treatment, (2) seedbed sanitation, (3) crop rotation, and (4) application of fungicides as sprays or dusts.

DAMPING-OFF

Description

Damping-off of pepper seedlings is caused by certain fungi [9] that often are present in the soil. These fungi may rot the seed or kill the seedlings before they emerge from the soil. They also may attack the soft stems of the young seedlings after they emerge and cause a water-soaking and shriveling of the stem at the ground line. Plants attacked in this way soon fall over and die. Damping-off is usually most damaging on very moist soil. Seedlings should not be overwatered, particularly in cool, moist weather, and should be grown in rows far enough apart to allow plenty of ventilation to keep down the humidity.

Control

Losses from damping-off can be reduced by treating the seed with certain fungicides that protect the young seedlings until they emerge from the soil. These materials include preparations of such chemicals as thiram [10] (Arasan, Thiram-50), 2, 3-dichloro-1,4-naphthoquinone (Phygon Seed Protectant), and hydroxymercurichlorophenol (Semesan). They should be used at the rate recommended by the manufacturer. The seed and chemical dust are placed in a tight container, which should not be over half-full. They are then shaken together for 1 or 2 minutes. The excess dust is screened off and the seed is ready to plant.

If damping-off has commonly been very severe in seedbed soil it can be controlled by chemical disinfectants. Good results can be

[9] Chiefly *Rhizoctonia solani* Kuehn, and certain species of Pythium.

[10] Certain organic fungicides are referred to in this bulletin by recently coined common names. These common names and the chemical names of the substances are as follows:

Common name	Chemical name
Ferbam	Ferric dimethyl dithiocarbamate
Ziram	Zinc dimethyl dithiocarbamate
Nabam	Disodium ethylene bisdithiocarbamate
Zineb	Zinc ethylene bisdithiocarbamate
Thiram	Tetramethylthiuram disulfide

These chemicals are marketed under various trade names such as Fermate Ferbam Fungicide, Ferberk, Ferradow, and Karbam-Black for products containing ferbam: Karbam-White, Zerlate Ziram Fungicide, Zirberk, and Corozate for those containing ziram; Dithane D–14, Thiodow-Liquid, and Parzate Liquid Nabam Fungicide for those containing nabam; Parzate Zineb Fungicide, Dithane Z–78, and Ortho Zineb for those containing zineb; and Arasan and Thiram 50 Dust for those containing thiram. (Use of trade names in this publication is solely to provide specific information. It does not constitute a guarantee or warranty of the products named and does not signify that they are approved to the exclusion of others of suitable composition.)

obtained by treating the soil with a solution of 1 gallon of commercial (40-percent) formaldehyde in 30 gallons of water. This is applied at the rate of 1 quart to each square foot of soil. The soil must be fairly moist and in a loose, friable condition. After the solution is applied, the soil is heavily watered and kept covered for 48 hours; then the covers are removed and the gas is allowed to escape. As soon as the soil is sufficiently dry, it should be worked to hasten the escape of the formaldehyde vapor. The soil must stand 10 days to 2 weeks before planting time to allow all the gas to escape. Formaldehyde must never be used where the fumes will reach plants, for they are killed by the gas.

Small quantities of soil in flats or benches may be treated with a solution of 1 part of formaldehyde in 5 parts of water. The solution is applied at the rate of one-half pint to each bushel of soil. The soil is spread in a thin layer, sprinkled with the solution, and then thoroughly mixed and placed in flats or benches. The mixture should stand for 24 hours before the seed is planted and should be thoroughly watered as soon as the seed is planted. Seedlings should never be transplanted into soil treated in this way until the odor of formaldehyde can no longer be detected.

Flats, benches, or hotbed frames that are to be filled with disinfected soil should be drenched with a solution of 1 part of formaldehyde in 30 parts of water and should not be used for 48 hours after the treatment.

Soil can be disinfected also by using chloropicrin or methyl bromide as described in the section on root knot (p. 31).

BLUE MOLD

Blue mold, or downy mildew, occasionally causes serious losses of pepper seedlings in the Southeastern States. It is caused by a fungus [11] that can develop and spread very rapidly in cool, moist weather. Blue mold is also a common and destructive disease in tobacco seedbeds.

Description

Pepper seedlings affected by blue mold show pale spots on the leaves. These spots become covered with a pale-blue coating of fungus spores on their undersurface. Very young plants soon may be killed and the bed will look as though it had been scalded. On older plants the infected leaves drop and the plants usually recover when the weather is again warm and dry.

Control

Blue mold can be controlled by spraying the seedbeds with preparations of ferbam or zineb. Dusting with one of these materials also should check the disease. If blue mold appears in the vicinity, the seedlings should be treated before the disease occurs in the seedbeds. (For methods of spraying and dusting see section beginning p. 29.)

BACTERIAL SPOT

Bacterial spot causes severe injury to sweet peppers but is not a serious disease of hot peppers. The disease is caused by a bacterium [12] that also causes bacterial spot of tomatoes. The most serious injury of peppers occurs on leaves and fruits. Stems are affected to a lesser degree.

Description

On young leaves the spots are small, yellowish green, and slightly raised on the under side of the leaf. On older leaves the spots first are dark, water-soaked, and not noticeably raised. When spots are few

[11] *Peronospora tabacina* Adam.

[12] *Xanthomonas vesicatoria* (Doidge) Dowson.

they may enlarge to an eighth or a quarter of an inch in diameter. Such spots have dead, straw-colored centers with a dark margin (fig. 13). When very numerous, the spots remain brown. Severely spotted leaves turn yellow and drop. Seedlings infected in the plant bed often lose all but the leaves at the top of the plant. Plants in the field also may lose many of their leaves.

On the fruit the small, blisterlike spots are roughly circular and may be a quarter of an inch in diameter. These spots turn brown and develop a cracked, roughened, and warty appearance (fig. 13). In damp weather various decay-producing organisms can enter through these spots and cause the fruit to rot.

The bacteria causing bacterial spot are seed-borne and apparently can live over winter on remains of old, diseased plants in the soil. Contaminated seed is a common source of first infection. Plants infected in the seedbed carry the disease to the field and are sources of further infection. Severe outbreaks of bacterial spot often occur after prolonged periods of warm, rainy weather, especially when driving rain and wind have caused mechanical injuries to the plants.

Control

Control of bacterial spot in the seedbed is the best way to prevent losses in the field. Seedlings should be grown on soil that has not been planted to peppers for several years. If soil must be used in which peppers have been grown, it is safest to disinfect it with one of the chemical treatments described for damping-off control (p. 18). Pepper seedlings should not be transplanted to fields where bacterial spot of peppers or tomatoes occurred the preceding year.

Pepper seed can be disinfected by soaking it for 5 minutes in a 1-to-

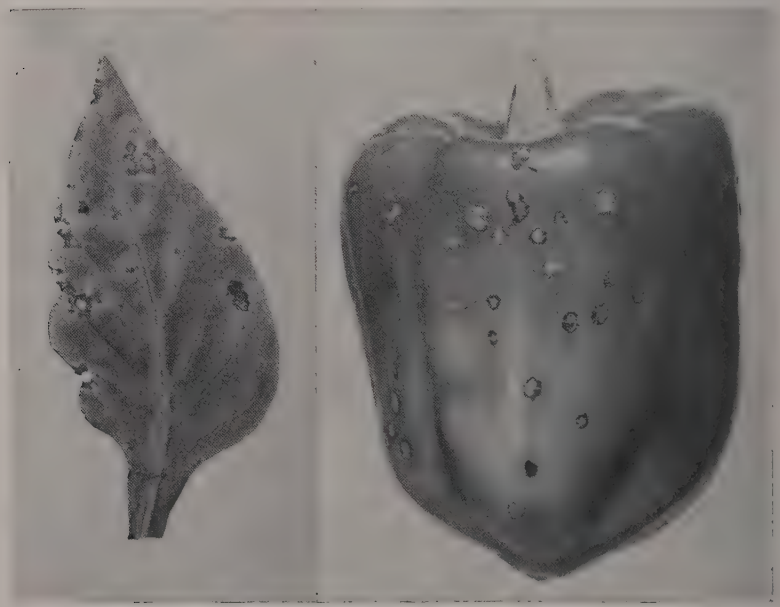

Figure 13.—*Bacterial spot: The small spots on leaf are brown, and the larger spots have light centers and dark margins; the spots on the fruit are slightly raised and have a cracked, roughened surface.*

2,000 solution of bichloride of mercury (corrosive sublimate), then washing for 15 minutes in running water or several changes of water, and then drying at once in a thin layer. This treatment is also of value in controlling other seed-borne diseases. It does not protect against damping-off, however. To obtain such protection the seed should afterward be treated with Arasan, Thiram–50, or Phygon Seed Protectant (p. 18), which do not contain mercury. Pepper seed is somewhat more sensitive to mercury than many other vegetable seeds; therefore, the use of Semesan, which contains mercury, occasionally may cause injury to seed already treated with bichloride of mercury. Only glass, enamel, earthenware, or wooden vessels should be used when seed is treated with bichloride of mercury, as the chemical corrodes metal containers. This chemical can be purchased from druggists in the form of 7.3-grain blue tablets or as a white powder. The use of the tablets is convenient, since 1 tablet dissolved in 2 pints of water gives a 1-to-2,000 solution.

If a large amount of seed is to be treated, two-thirds ounce of the powdered chemical should be used for 10 gallons of solution. The powder first is dissolved in a small amount of boiling water. Enough water is then added to make 10 gallons of solution. Seed to be treated is placed in a loosely woven cloth bag. The bag should not be filled more than halfway. Stir the seed while treating and always use at least 3 times as much solution as seed by volume.

In the South, freshly harvested pimiento seed frequently is treated by being soaked for 90 minutes in a 1-to-400 solution of Semesan and then dried.

If clean soil and chemically treated seed are used, the disease is not likely to occur in the seedbed but the application of suitable sprays or dusts is a safeguard against possible infection.

Seedlings may be sprayed or dusted with a fixed copper compound or sprayed with a 6–6–100 bordeaux mixture. Fixed copper compounds are less likely to injure the seedlings. A preparation of a fixed copper combined with streptomycin (Agri-mycin 500) has given good control of bacterial spot when used at a rate of 5 pounds to 100 gallons of water. This gives a concentration of 4 pounds of a fixed copper (53 percent) and 100 parts per million of streptomycin. If desired, the streptomycin content can be increased to 200 parts per million by adding the necessary amount of some formulation of streptomycin such as Agristrep, Phytomycin or Agri-mycin 100.

In the field, losses from bacterial spot can be reduced by spraying or dusting as recommended for the control of the disease in seedling plants. Copper fungicides sometimes are slightly injurious to peppers and may cause some reduction in yield when several applications are made. The organic fungicides (p. 18) used for the control of some other pepper diseases are not recommended for control of bacterial spot. ***Caution:*** **Streptomycin should not be applied to pepper plants after the fruits begin to form.**

Directions for the preparation and application of copper fungicides are given in the section on spraying and dusting, page 29.

CERCOSPORA LEAF SPOT

Cercospora leaf spot, sometimes called frog-eye spot, is a common disease in many sections where peppers are grown. It is caused by a fungus [13] that often causes serious defoliation of peppers. The fungus attacks both sweet and hot peppers with about the same severity.

[13] *Cercospora capsici* Heald & Wolf.

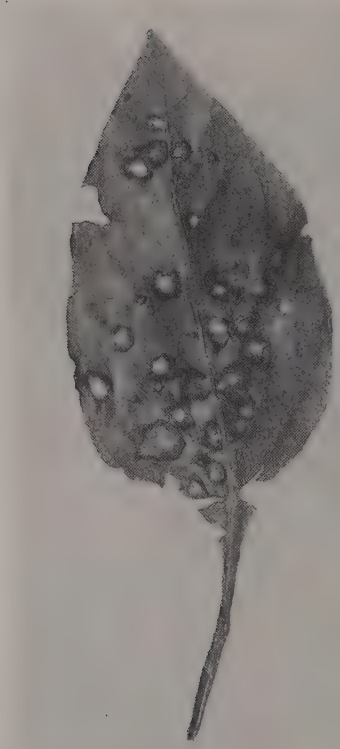

Figure 14.—*Cercospora leaf spot of peppers. The roughly circular spots have dark margins and light-gray centers. These spots are larger than those of bacterial spot.*

Description

Cercospora leaf spot is characterized by large, circular or oblong spots on the leaves and stems. These spots, which become dark brown at the margins and usually have light-gray centers, may be as much as a quarter to a half inch in diameter (fig. 14). Severely infected leaves turn yellow and drop. Infection of the leaf stems also causes some defoliation of the plants.

The fungus apparently does not live in the soil but is carried on the seed. Much field infection can be traced to infected seedlings grown from contaminated seed. The spores of the fungus causing cercospora leaf spot are spread in the same manner and under the same conditions as the bacteria that cause bacterial spot (p. 19).

Control

Cercospora leaf spot is controlled by the same methods of seed treatment described for bacterial spot (p. 20) and by spraying or dusting in the seedbed and field with copper compounds or with organic fungicides containing zineb or nabam (used with zinc sulfate). These organic compounds are less injurious to peppers than copper fungicides and are effective for control of Cercospora spot. Directions for the preparation and application of these materials are given in the section on spraying and dusting, page 29.

SOUTHERN BLIGHT

Description

Southern blight[14] is a common and destructive disease of peppers in the Southeastern and Gulf States. It also attacks many other vegetable and field crops and ornamentals.

During warm, rainy weather the fungus attacks the stem of the pepper plant near the ground line and eventually girdles it. The diseased plant droops, the leaves wilt, and the plant finally dies. When a plant is pulled up, a white mat of the fungus can be seen on the stem. In this mat there usually are embedded numerous small, light-brown bodies about the size of a cabbage seed. These bodies, known as sclerotia, are a distinguishing character of the disease.

The fungus infests the soil but makes little growth at temperatures below 70° F. Threads of the

[14] Caused by the fungus *Sclerotium rolfsii* Sacc.

fungus spread through the soil and the sclerotial bodies can be distributed by water or cultivation. Under favorable conditions these sclerotia put out fungus threads and infect the plant. The fungus lives a long time in the soil and is most active in sandy, poorly drained fields.

Control

Sanitation is important in the control of southern blight. If only an occasional infected plant is found, it should be pulled and burned. This is particularly important in small plantings. Rotation is very important. Fields in which the disease previously has been severe should not be planted to peppers or other highly susceptible crops for at least 4 years. Seedbeds should not be located on land where southern blight has occurred.

PHYTOPHTHORA BLIGHT

Phytophthora blight occurs chiefly in the Southwestern and Gulf States. It is caused by a fungus [15] that lives in the soil from year to year and may be carried on the seed.

Description

The infected plant commonly is girdled at the soil line, causing a sudden wilting and death of the plant. The diseased part of the stem shows a dark-green water-soaked band that dries and turns brown. Branches also may be infected. Leaves first show small dark-green spots that enlarge and then become dried and bleached as though scalded by the sun. Infected fruits first show dark water-soaked patches. These patches become coated with a white growth of the fungus, and the fruit finally withers but remains attached to the plant. The seeds are attacked and may either turn dark and shrivel or retain a normal appearance.

Control

Since the fungus can live in the soil, it is important to locate seedbeds on land that has not grown peppers. Seed treatment with bichloride of mercury, as recommended for bacterial spot (p. 20), may help to prevent infection. Rotation is essential, and peppers should not follow peppers on the same land for several years. Spraying with fixed copper fungicides, bordeaux mixture, or preparations containing zineb or nabam (used with zinc sulfate) may help to control the disease. Directions for the preparation and application of these materials are given in the section on spraying and dusting, page 29.

FUSARIUM WILT

Description

Fusarium wilt of peppers is most common on chili peppers in the Southwest. The fungus [16] causing the disease lives in the soil but does not seem to be carried in the seed. The first symptom of wilt is a drooping of the lower leaves, and later of all the leaves of the plant. The stem is attacked near the ground and shows sunken brown cankers that finally girdle the plant. Roots are also attacked. These become dark brown and are soft and water-soaked.

The fungus that causes fusarium wilt can live almost indefinitely in the soil and is spread on wind-blown particles of soil and by irrigation water. The disease is most damaging on heavy, poorly drained soils and is favored by temperatures of about 80° F.

[15] *Phytophthora capsici* Leon.

[16] *Fusarium annuum* Leon.

Control

Losses from wilt can be reduced by using well-drained land for chili peppers and by using a ridge-and-furrow method of culture (p. 8). This method, when combined with careful handling of irrigation, seems to retard the progress of the disease.

The fusarium-resistant variety, College No. 9 chili, developed by the New Mexico Agricultural Experiment Station, should be used where soils are known to be infested.

ANTHRACNOSE

Description

Anthracnose rot[17] causes some damage in most pepper fields. Infected fruits develop dark, circular, sunken spots that vary in size but often are an inch or more in diameter (fig. 15). These spots, which may occur on either green or ripe fruits, become covered with dark, raised specks that are bodies containing spores of the fungus. In moist weather the spots may be coated with salmon-pink masses of spores. These spores are washed or spattered by rain to other fruits; thus, in rainy seasons losses may be severe. The fungus grows through the flesh into the seed cavity of the fruit and can penetrate the seed coat. The seed surface may also be contaminated with spores during the harvesting process. When the fungus is present on or in the seed, it can infect the leaves and stems of the young seedling and remain on the plant throughout the season, although it does not cause much injury to leaves or stems.

Similar spotting of the fruit is caused by another fungus[18] that is related to the one causing anthracnose, but which can attack the fruit only through wounds or injuries such as those caused by blossom-end rot.

Figure 15.—*Anthracnose spotting of pepper. The centers of the spots show numerous dark specks, bodies that contain spores of the fungus.*

[17] Caused by the fungus *Gloeosporium piperatum* E. & E.

Control

Disinfection of the seed as recommended for bacterial spot (p. 20) will destroy the anthracnose fungus on the surface of the seed but will not kill the fungus if it is within the seed coat. However, losses can be reduced by harvesting only the seed from sound fruits and by careful handling of seed during harvest to avoid contamination with the fungus. Application of zineb, nabam (used with zinc sulfate), or ziram help to prevent fruit rot.

RIPE ROT

Description

Ripe rot is particularly serious on pimiento peppers. It is known as ripe rot because the spotting appears only after the fruit becomes red, although infection may occur while the fruit is still green. As the infected fruits ripen, inconspicuous, small, yellowish spots develop. After the fruits have been picked and held for several hours, the spots

[18] *Colletotrichum nigrum* Ell. & Hols.

on many of them become large and soft.

Ripe rot is caused by a fungus [19] which, like that causing anthracnose, can penetrate the seed cavity and infect the seed. The fungus is known to live at least for a time on decaying fruits in the field.

Control

Recommendations for control of ripe rot are the same as those for control of anthracnose. To procure seed free from the ripe rot fungus it is safest to take it from fields known to be free from this disease.

MOSAIC DISEASES

Peppers are infected by a number of mosaic disease viruses that can cause severe losses. The tobacco mosaic virus [20] (which also causes the common form of tomato mosaic) is prevalent on peppers, and they also are frequently infected with the tobacco etch virus [21] and the virus causing the common form of cucumber mosaic.[22] These viruses often occur in combination in the same plant.

Description

The young leaves of plants affected by the tobacco mosaic virus show a greenish-yellow mottling and may be slightly curled and irregular in shape (fig. 16). Tobacco mosaic virus often causes a brown streaking of some of the branches; this causes a yellowing and dropping of the leaves. At times, plants affected by this virus may show a general yellowing of many of the leaves with little streaking of the stem. The common (green mottle) form of tobacco mosaic often causes little if any mottled symptoms on the fruit. However, fruits on streaked branches that have dropped many leaves often are yellow, wrinkled, and withered. One strain of this virus causes a brilliant-yellow mottling of the leaves. It may also cause a yellow spotting of some fruits. The spots are of irregular shape and not noticeably sunken or wrinkled.

Plants infected with the common form of the cucumber mosais virus develop a mottling somewhat like that of tobacco mosaic but with

[19] *Vermicularia capsici* Syd.
[20] *Marmor tabaci* Holmes.
[21] *Marmor crodens* Holmes.
[22] *Marmor cucumeris* Holmes.

Figure 16.—*Young pepper plant leaves, showing the mottling and curling caused by the tobacco mosaic virus.*

more contrast between the light and dark portions of the leaf. The leaves curl upward at the edge and often are abnormally narrow and pointed. Plants infected with this virus produce few fruits, and those produced sometimes are misshapen and have dark-green raised spots on the surface. Infected plants often are abnormally short and compact in appearance. Recently, it has been found that there is a strain of the cucumber mosaic virus that produces yellow rings on the leaves and fruits. These rings are a quarter to a half-inch in diameter. On the fruits, they are slightly sunken and have concentric markings. When both the cucumber and tobacco mosaic viruses infect the same plant, there is more yellow mottling of the foliage than occurs with either virus alone. The fruits also show more mottling than those from plants infected only with cucumber mosaic.

Peppers infected with the tobacco etch virus show a green and yellow mottling somewhat like that caused by cucumber mosaic, although at times the symptoms may be less pronounced. There are no symptoms on the fruits, but yields are somewhat reduced. When plants are infected with both the tobacco mosaic and the tobacco etch viruses, there is a strong yellow mottling of the young leaves. Some of the older leaves become bleached with yellow and then drop. On such plants, yellow-green circular spots about one-fourth inch in diameter often appear below the smooth surface of the green fruits. As the fruits ripen the spotted parts become more yellow and they shrivel slightly. The spots are left raised in a way that gives the fruits a characteristic roughened appearance (fig. 17).

The viruses mentioned above do not seem to be carried in the seed, and only with tobacco mosaic virus is there any evidence of possible

Figure 17.—*Pepper from a plant affected by both the tobacco mosaic and tobacco etch viruses. The fruit is yellowed and wrinkled and shows dark raised spots on the surface.*

overwintering in the soil. However, virus infection can occur if even a minute amount of sap from a diseased plant enters any slight wound or break in the leaf of a healthy plant. Mosaic viruses can be transmitted merely by handling or brushing against first a diseased and then a healthy plant. Many viruses are commonly transmitted also by aphids. These insects become carriers of the virus after feeding on mosaic plants.

The virus of tobacco mosaic remains active in dried tobacco leaves and frequently is present in manufactured tobacco. As smokers' hands often carry the virus some seedling infection comes from this source. Tobacco mosaic is common on greenhouse tomatoes. Pepper seedlings grown in the same greenhouse may become infected from the hands of workers who previously have handled mosaic-infected tomato plants. This virus occasionally may live for a time on the remains of dead plants in the soil, but soil transmission probably is rare with peppers. Tobacco mo-

saic virus apparently is not carried in pepper seed. Certain perennial weeds, such as wild groundcherries and horsenettle, sometimes are infected with this virus. Such infected weeds may possibly be a source of infection to peppers, but this has not been definitely established.

The cucumber mosaic virus apparently is not carried in the seed and does not live over in the soil. However, it occurs on perennial weeds such as wild groundcherries, milkweed, and catnip and also on certain perennial ornamental plants. Aphids may carry the virus from perennials to cultivated crops. This virus also affects cucumbers, melons, celery, and tomatoes. Fields planted with these crops can be a source of infection to nearby pepper fields.

The common source of tobacco etch virus has not been worked out, but it occurs on tobacco and also infects a number of other plants susceptible to tobacco and tomato mosaic. Apparently tobacco etch virus does not live long in the soil and is not carried in the seed. It is transmitted by some of the aphids that transmit cucumber mosaic.

Control

On the basis of the above facts, the most important directions for control of mosaic diseases of peppers are as follows: (1) Remove or destroy all perennial weeds in and near the seedbeds and field. (2) Wash the hands well with soap and water before working in the seedbeds and handle the seedlings as little as possible. Washing removes any virus on the hands. (3) Prohibit the smoking or chewing of tobacco by those handling pepper seedlings. The workers may be allowed to smoke at intervals if they wash their hands before again working with the plants. (4) When peppers are grown in or near a greenhouse where there is a crop of tomatoes, it is safest to finish work with the peppers before working with the tomatoes, since greenhouse tomatoes almost always are affected with mosiac. In any case, the hands should always be washed before working with the pepper seedlings. (5) Use insecticides to control aphids in the seedbeds and field. (6) Avoid planting pepper fields close to tobacco, tomatoes, cucumbers, muskmelons, or celery, because one or more of the viruses affecting peppers occur on all these crops.

If carefully followed, these measures should help to prevent severe outbreaks of mosaic diseases in the field. When mosaic does appear in the field it is advisable to use insecticides for aphid control. Ordinarily, it does not pay to rogue mosaic plants from the field.

The pepper varieties Burlington, Rutgers World Beater No. 13, Yolo Wonder, Keystone Resistant Giant, and Liberty Bell, have considerable resistance to the tobacco mosaic virus.

CURLY TOP

Curly top of peppers is caused by the virus [23] that causes curly top of sugar beets. This virus is destructive also in tomatoes, beans, spinach, and certain other vegetable crops. The disease occurs in California, Utah, southern Idaho, and eastern Washington and Oregon. It has also caused losses at times on vegetable crops in western Colorado and in Texas and other Southwestern States.

Description

Peppers infected with the curly top virus show an upward rolling of the margins of the older leaves and a pronounced curling of the younger leaves. The petioles of the leaves curve sharply downward. In later stages of the disease the plant becomes yellow and is much dwarfed. Fruits produced after in-

[23] *Ruga verrucosans* Carsner & Bennett.

fection of the plant are small, quite deformed, and few in number.

The curly top virus is transmitted only by the beet leafhopper.[24] These insects become carriers of the virus by feeding on plants that are infected with the curly top virus. The beet leafhoppers are migratory insects that have their breeding grounds in sagebrush areas and weedy, abandoned lands west of the Rocky Mountains. Some wild plants on which the insects live during the winter may be infected by the virus, and some insects of the spring broods of leafhoppers then become carriers by feeding on such plants. When these insects later migrate into cultivated fields they may transmit the virus to any susceptible plant on which they feed. The severity of curly top in any given season depends on the number of insects carrying the virus and the age of the plants at the time the insects appear.

Control

There is no effective means of controlling curly top in peppers. Leafhopper control is not yet sufficiently effective to prevent a considerable amount of infection. A serious difficulty is the great extent of the winter breeding grounds of the insects.

As the leafhopper prefers to breed in the open, the amount of infection is reduced when plants are shaded. Some protection can be obtained by covering individual rows of young plants with tentlike covers of muslin that are supported by stakes or wire running the length of the rows. The cloth is anchored to the ground by covering the edges with soil. Such covers can be lifted when the plants are to be weeded. When the plants become so large that they touch the cloth, the covers should be removed. At this stage of growth the plants are likely to be injured much less severely by curly top than when they are small. This method, because of the extra expense for cloth and labor, is suited only to small plantings.

BLOSSOM-END ROT

Description

Blossom-end rot is a common disease of peppers. It is not caused by any parasitic fungus or bacterium. The rot occurs when the soil moisture becomes low, after a period of abundant moisture during which the plants have made rapid growth. Under such conditions the tissues near the blossom end of the fruits die. Excessive fertilization with nitrogen increases susceptibility to blossom-end rot. Too close, deep cultivation just before or during a hot, dry period may materially increase this disorder.

The spots characteristic of blossom-end rot are found on or near the blossom end of the fruit and usually when the fruit is about half-grown. The affected areas first may consist of one or more small, water-soaked spots or they may cover half the fruit. These spots soon become dry, light-colored, and papery. Many affected areas, attacked by various fungi that grow over the dead tissue, become dark-colored.

Control

Since blossom-end rot is likely to occur when soil moisture is low, measures that insure a fairly even soil moisture throughout the season will help to reduce losses. Soils well supplied with organic matter will hold moisture longer than those where organic matter is low. In planting peppers it is best to avoid land that dries out rapidly after rain. Avoid excessive applications of nitrogen and try to maintain a uniform, uninterrupted growth. There is evidence that calcium deficiency is related to blossom-end rot in tomatoes and

[24] *Circulifer tenellus* (Baker).

the use of lime (p. 3) may help to prevent blossom-end rot in peppers. Avoid forcing too rapid growth during the early part of the season if dry weather commonly occurs after the fruits have set.

SUNSCALD

Description

Sunscald of peppers occurs on parts of the fruit exposed to direct sunlight. The first evidence of the disease consists of a light-colored area that is soft and may be slightly wrinkled. Such a spot is irregular in outline and often covers as much as one-third of the side of the fruit. As the injured area dries it becomes slightly sunken and has a white, papery appearance (fig. 18). Such spots are frequently infected by various fungi that grow over the dead tissue and often cause a decay of the fruit. Partial defoliation of the plants by bacterial spot or cercospora leaf spot is often followed by considerable loss of fruit from sunscald.

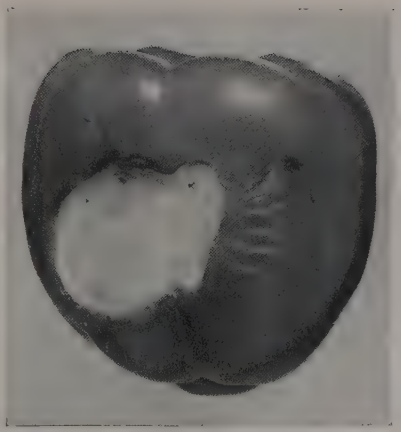

Figure 18.—Pepper showing injury from sunscald. The injured area is dry, white, and slightly sunken.

Control

The fruits of plants kept in a healthy, vigorous condition are not likely to be much injured by sunscald. Control of bacterial spot and cercospora leaf spot will prevent loss of the leaves and keep the fruit protected from the direct rays of the sun.

SPRAYING AND DUSTING

Losses from such diseases as bacterial spot, cercospora leaf spot, phytophthora blight, and fruit rots may be somewhat reduced by the application of the right fungicides. It should be remembered, however, that these fungicides can only protect plants from infection—they cannot cure diseased plants. Good results can be obtained only if spraying or dusting begins before the disease is prevalent throughout the field and if the fungicide thoroughly coats the plants.

Effective spraying can be done by the use of power machinery of the type used for spraying potatoes or tomatoes. The machine should be capable of applying 150 to 200 gallons per acre at 300 pounds' pressure and should have three or four nozzles per row. At least one nozzle should be above the plants. Spraying is preferable to dusting because the spray sticks better to the plants. However, dusting can be quite effective if the material is properly applied. A dusting machine should deliver a steady and uniform cloud of dust, and 40 to 50 pounds should be applied per acre. To obtain thorough coverage of the plants and effective sticking of the dust, dusting should be done early in the morning or toward evening—when the air is calm and the plants are likely to be wet with dew.

Fungicides should be applied to peppers at intervals of 7 to 10 days. In long periods of dry weather, a 10-day interval probably is not too long, but a 7-day interval is safest for control of leaf diseases in sections where there are likely to be

frequent periods of high humidity and wet weather during the growing season.

Precautions

Chemicals used as soil fumigants and fungicides are injurious to man or animals if taken internally; some are very poisonous. Use these chemicals carefully to keep them from getting into the mouth, eyes, or nose. Care must be taken to avoid inhaling chemicals used in dust form. When treating a large quantity of seed with a dust or dusting plants in the field, wear a respirator or dust mask.

No mask is needed when small quantities of seed are treated in the open air or in a well-ventilated room. Pour out the unused spray solution or mixture in such a way that it will sink into the ground and not stand in puddles. Clean thoroughly all vessels used in preparing a spray solution and plainly label all containers of chemicals. Keep the chemicals locked up or, at least, out of the reach of children.

Fixed Copper Sprays

The fixed, or neutral, copper compounds include such preparations as basic copper sulfates, copper oxychloride, copper oxychloride sulfate, and cuprous oxide. These compounds, sold under various trade names, are used for control of leaf spots and fruit rot of peppers. They cause somewhat less injury to the plants than is caused by bordeaux mixture.

These preparations should be used on a basis that gives about 2 pounds of copper (calculated as metallic copper) to 100 gallons of water. The copper content of each preparation is shown on the label, and the amount needed can be calculated from this. For example, 4 pounds of a compound containing 50 percent of copper is needed to give 2 pounds of copper in 100 gallons of water. With a preparation containing only 25 percent of copper, 8 pounds would be needed.

Fixed Copper Dusts

Fixed copper dusts can usually be bought from dealers in agricultural supplies. A dust containing 5 percent of actual copper can be used. These dusts are prepared by mixing the necessary amount of a fixed copper compound with talc, pyrophyllite, or some other light, inert ingredient. If the compound used contains 50 percent of copper, 10 pounds of it are mixed with 90 pounds of the inert carrier to make a 5-percent dust.

Bordeaux Mixture

Bordeaux mixture is an excellent fungicide, but it is slightly more injurious to pepper plants than are the fixed coppers, especially when the plants are small. It is best to use a 6–6–100 mixture—6 pounds of copper sulfate (bluestone), 6 pounds of hydrated spray lime, and 100 gallons of water. In preparing such a mixture, a finely powdered form of copper sulfate that dissolves rapidly in water can be used. The powdered copper sulfate is placed on the screen of the spray tank and is dissolved as water, enough to fill two-thirds of the tank, flows through the screen. The solution is then agitated, and the lime, in a thin paste, is washed in with enough water to fill the tank.

Ferbam

In preparing ferbam as a spray, 2 pounds of the commercial product is added to 100 gallons of water. When used as a dust, 8 pounds of ferbam is mixed with 92 pounds of talc or some other suitable carrier. Ferbam is effective for control of blue mold on pepper seedlings.

Zineb

When zineb is used as a spray, 2 pounds of the commercial product is added to 100 gallons of water. When used as a dust, 6 pounds of zineb is mixed with 94 pounds of talc or some other suitable carrier. Zineb is effective for control of blue mold of pepper seedlings and has been used for control of leaf spot diseases and fruit rots.

Nabam

Nabam is an organic compound that is used only as a spray. In making the spray, 2 quarts of the commercial product is added to 100 gallons of water. To this is added 1 pound of zinc sulfate. When prepared in this way, the reaction product is closely related to zineb. Nabam combined with zinc sulfate has been used for control of leaf spots and fruit rots of peppers.

Ziram

When ziram is used as a spray, 2 pounds of the commercial product is added to 100 gallons of water. For use as a dust, ziram is mixed with talc or some other suitable inert carrier at the rate of 8 pounds of ziram to 92 pounds of the carrier. Ziram occasionally is used for control of leaf spot diseases. It may also help reduce fruit rots.

ROOT KNOT

Description

Peppers are subject to the attack of various nematodes, or eelworms. These are minute organisms usually not visible to the naked eye. Various kinds live by the millions in the croplands of the United States. Many attack plants. Unfortunately many growers are not even aware of the existence of these pests. Of the various kinds of these organisms, the root-knot nematodes [25] appear to cause the most damage. They occur in most of the States but are not common in those in the far North. They often cause serious damage in the sandy soils of the South. They are a greenhouse pest everywhere.

Root-knot nematodes produce swellings, or galls, on the roots. Above-ground symptoms of affected plants are wilting and a lack of vigor, particularly during the hot part of the day or during dry weather. Seedlings and young pepper plants suffer much more from nematode injury than older plants. It is, therefore, essential to protect the young plants from attack. After long feeder roots have been developed, attacks by nematodes cause much less damage.

Control

Peppers should be planted on land free from root-knot nematodes. A crop rotation for 2 or 3 years with small grains, hairy indigo, various crotalarias, or, in some regions and locations, with peanuts, will help to clean land of these pests.

Injury due to root-knot or other nematodes can usually be controlled or substantially reduced by the use of soil nematocides. These are chemicals sold especially for this purpose and since many are fumigants, are sometimes called soil fumigants. In the field, they are applied by injection into the soil at a depth of 6 to 8 inches at least 2 weeks before the crop is planted. The whole area of the field may be fumigated by applications spaced at 10- to 12-inch intervals, the chemical being applied by means of a special applicator attached to a tractor. These applicators deliver the chemical in continuous streams behind shanks pulled through the soil. Or good results can be ob-

[25] *Meloidogyne* spp., formerly known as *Heterodera marioni* (Cornu) Goodey.

tained with a considerable saving of chemical by the use of "row fumigation," that is, by the application of a single stream of fumigant directly under the row.

Nematocides suitable for field use contain dichloropropene, dibromochloropropane, or ethylene dibromide as the active ingredient. Formulations vary and specific recommendations for use cannot be given. The user should follow the manufacturer's recommendations exactly and should also seek advice from local county agents, State experiment stations, or the U. S. Department of Agriculture.

Control of nematodes in the seedbed is also very important, since plants infected with nematodes in the seedbed will not grow properly in the field and in addition, may introduce nematodes into the field soil. The nematocides mentioned above may be used in the seedbed, but there are various mixtures and special chemicals for this purpose. Some of these have the advantage of controlling other soil organisms and weed seeds in the seedbed. Those in general use at present contain methyl bromide, chloropicrin, or sodium methyl dithiocarbamate, but formulations containing several other chemicals may be available on the market in the near future.

Materials containing methyl bromide are applied by releasing under a gastight cover placed over the seedbed with the edges buried. Other materials are applied as drenches or by injection as described above. As with the materials for use in the field, manufacturer's direction should be followed exactly and information on use under local conditions obtained from county agents, experiment stations, or the U. S. Department of Agriculture.

When handling soil fumigants avoid prolonged breathing of the fumes. Do not allow the liquids to remain in contact with the skin; wash promptly with soap and water. If the liquid is spilled on clothing, the affected articles should be quickly removed. Never risk getting the liquid into the eyes or mouth. Chloropicrin is very toxic to plants; therefore, it should not be used where there is danger of the fumes coming in contact with plants growing in the vicinity. No soil fumigant should be applied within 30 inches of the roots of plants.

HARVEST AND PREPARATION FOR MARKET

Mild-fleshed peppers for fresh use are harvested, with stems attached for the most part, when the individual fruits are practically mature but before they begin to lose their dark-green color. Young, immature peppers are rather soft and yield readily to mild pressure of the fingers. Although quite edible at such a stage, they have not yet developed as high a content of vitamins and other food value as they will have when fully grown. Immature fruits give neither the full yield nor the high quality that they will produce when fully grown. Also, immature fruits do not stand up so well during shipping or marketing as mature-green fruits. Green fruits ready for harvest are relatively firm and crisp.

Peppers to be brined are harvested in both the mature-green and red-ripe stages, and limited quantities of mild-fleshed varieties other than the Perfection pimiento are harvested either green or red for canning. Pimiento and paprika varieties are harvested when dark-red ripe.

Most hot peppers are harvested ripe for drying. Some, depending upon the product to be prepared from them, are harvested either green or ripe. The Tabasco type is harvested fully red ripe.

Strong cloth picking bags suspended from the shoulders of the

pickers are preferable to baskets or boxes because they leave both hands free for rapid and careful removal of the fruit from the plants. Bags holding about a bushel and provided with a bottom opening can be filled and emptied into other field containers with no objectionable bruising of the fruit.

Field-run peppers are carried to a central point where they are graded and packed in standard baskets or hampers for shipment, or graded and put in containers for delivery to the processing plant.

The U. S. Department of Agriculture has formulated standards for mild-fleshed, or sweet, peppers. Copies may be obtained from the Agricultural Marketing Service, Department of Agriculture, Washington 25, D. C. The standards should be used as a guide in grading fresh sweet peppers for market. Buyers of peppers for processing also use standards with which growers should be familiar, whether they are growing peppers under contract or for open-market sale to the processor. There are no U. S. official grades for kinds other than fresh sweet peppers.

In the Anaheim, Calif., district, chili peppers are dried chiefly by artificial heat in special drying houses. In the Southwest they are sun-dried, for the most part, before they are sold. The "red" peppers and paprika peppers grown in South Carolina are sun-dried. The fruits of the large types of hot peppers are flattened before drying is completed. This is to facilitate packing in bags for market. The small-fruited forms, not flattened, are also generally marketed in bags. Some, however, are sold to local buyers in the Southwest in strings or bunches about 5 feet long.

Peppers that have been dusted or sprayed with poisonous substances must be washed to remove residues of those substances before being marketed or processed.

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